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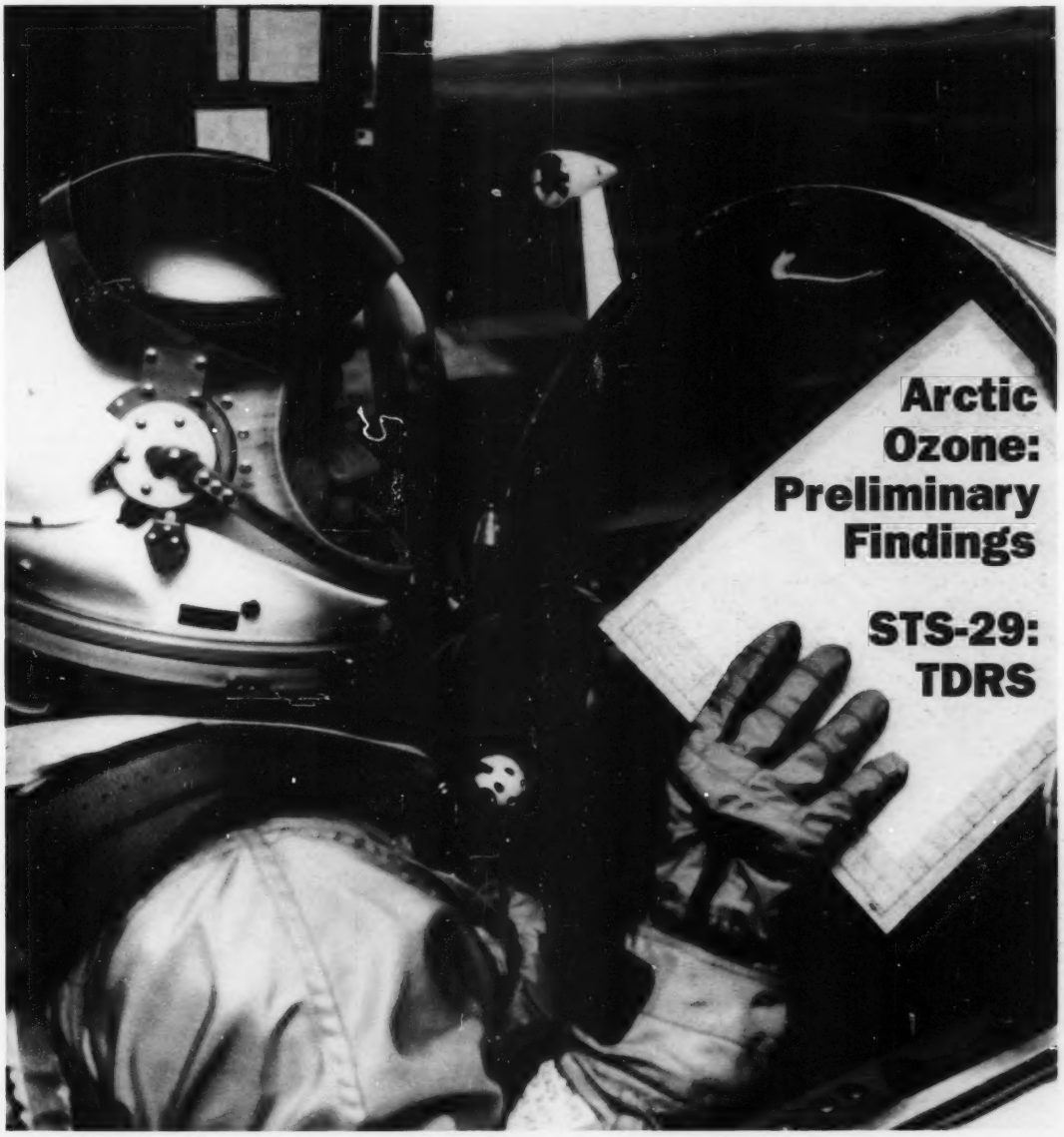

Arctic Ozone: Preliminary Findings

STS-29: TDRS

THIS ISSUE

The very texture of the fabric of manned space exploration is at stake as the nation now turns its attention to NASA's budget. And NASA's Administrator Dr. James C. Fletcher addresses U.S. space leadership issues in this month's "Official Comment" column.

The Office of Procurement is highlighted in the "Inside NASA" column. The who, where, how and when of NASA's buying is examined. Also, the new employee benefits statement is explained.

Leading off "Agency Highlights" this month is a report from Stavanger, Norway, on the condition of Arctic ozone...and the picture is not pretty. The Arctic expedition is outlined.

The mission of STS-29, its payload, crew and experiments are presented in this issue, as is NASA's participation in Superbowl XXIII. Pardon our Monday morning quarterbacking!

NASA's anti-drug program and its approach is also called to your attention, as is Goddard's splendid performance is obtaining this year's Equal Opportunity Trophy.

Kudos also to Lewis Research Center for winning OMB's Quality Improvement Prototype Award.

A new truck aerodynamic device has been tested in Ames wind tunnels and it may mean good news to all the good buddies out there between the "Big Apple" and "Shakeytown."

Next Month:

Aerospace Computing: Some NASA Contributions.

CONTENTS

U.S. Space Leadership in Danger....3
Inside NASA: When NASA Buys: The Office of Procurement....4
Statement of Benefits: Concise and a Time Saver....5

Agency Highlights
Arctic Ozone: Preliminary Findings from Stavanger....6
STS-29: Completion of the TDRSS Constellation....8
Orbital Debris Study Completed....11
NASA Announces Program for a Drug-Free Workplace....11
Goddard Receives NASA Equal Opportunity Trophy....12
Cosmos Mission Results and Future U.S./U.S.S.R. Missions....12

Center Highlights
SHARE: Ammonia-Powered "Air Conditioner"....13
Ames Truck Aerodynamic Device Could Lead to Major Savings 14
Effects of Clouds on Climate Measured by NASA Project....14
OMB Announces Lewis Winner of Quality Prototype Award....15

Departments
Q&A: Artificial Gravity....16
Congressional Corner: Committee Assignments....17
NASA News Capsules....18
Human Factors....19

About the Cover

NASA ER-2 Pilot Doyle Kumrey makes final preparations prior to takeoff on a atmospheric sampling mission north of Stavanger, Norway. Flight plans and other data are being stowed by Kumrey, who is already strapped into the cockpit. Preliminary findings on the ozone investigation may be found on page 6.

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U.S. Space Leadership in Danger, NASA Chief Warns

"...a terrible question remains unanswered: what language, what culture, what values will shape the ethos of the first human settlement on Mars?"

NASA administrator, Dr. James C. Fletcher, has declared that the budget proposed for the space agency is "as taut as possible" and "even a nick can mean organic rupture and collapse" of the U.S. civil space program.

Speaking recently to the Explorers' Club in New York City, he warned that if the space budget is made the "banker" to finance other federal programs, the U.S. would relinquish world space leadership for good and would run the risk of becoming a "historic relic" with other societies that lost their vitality, sense of adventure, willingness to risk, and their places in the forefront of technology development.

Mankind certainly will reach other planets, Fletcher declared. "But a terrible question remains unanswered: what language, what culture, what values will shape the ethos of the first human settlement on Mars?"

Fletcher made these and other points:

- The Space Station has been subject to so much redesign and modification that "there is simply no room for further trimming, or shaping or cutting. We either are going to build it - and build it right - or not build it at all."
- The space program "is an integral, interdependent whole" that is vulnerable to serious dislocation by even small budget cuts. "The funds being requested do not permit us the luxury of backups, of alternatives, of programmatic robustness. Virtually every element of the program is being pursued on a success schedule..."
- "The accomplishments of the past and the continuing promises of the future have come at an astonishingly low price for the values received - this year, for example, the entire NASA space and aeronautics program represents less than 1 percent of the federal budget."

Who's exploring Noctis Labyrinthus?

"In truth," the NASA administrator said, "the moment is coming when the nation chooses to lead - or to follow. I want to be as certain as I can that that choice is made knowingly and not by default." ■

INSIDE NASA

When NASA Buys:

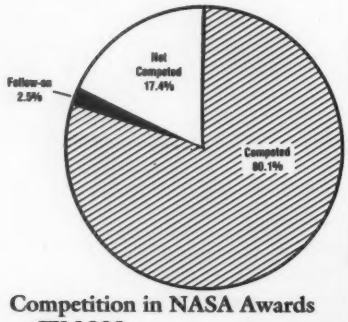
The Office of Procurement

Procurement is big business at NASA. Of each dollar appropriated to NASA, 88 cents is expended through the procurement process. Our procurement awards, which totaled $9.5 billion in FY 1988, were the third largest of all Federal Departments and Agencies. Some 109 thousand different procurement actions were involved.

The NASA procurement function is decentralized. Most (93 percent in terms of dollars) of NASA's purchases and contracts are made by the procurement offices and their personnel at field installations across the United States.

Full and Open Competition

Key to spending of NASA funds is the concept of "full and open competition." This type of competition is a required standard within the government to allow all responsible sources opportunity to competitively bid. Of $7.4 billion available for competition in FY 1988, eighty percent, or $5.9 billion was awarded on a competitive basis.



Competition in NASA Awards — FY 1988

Noncompetitive procurements occur only when it is not feasible to provide for competition as a result of a limited number of exceptions authorized by law. An example would be the noncompetive procurement of the replacement Shuttle orbiter, where only one source had the current capability to meet NASA's requirements.

Competition in NASA Awards — FY 1988

Of the $5.9 billion in competitive awards, 18.5 percent were for new contracts while 81.5 percent were for in-scope modifications representing incremental funding and change orders to contracts awarded on a competitive basis in prior years. Most competitive awards (88.8 percent or almost a $billion) were awarded through negotiation rather than sealed bidding, reflecting NASA's reasearch and development nature.

With respect to noncompetitive procurements, new awards amounted to $193 million or 15.1 percent while the remainder reflected contract modifications.

Who are We Doing Business With?

Almost $7.3 billion was awarded to business firms, representing 76 percent of total obligations. Awards to the California Institute of Technology to operate the Jet Propulsion Laboratory amounted to about 10 percent of total obligations, or $979.9 million. Awards to other educational and non-profit organizations totaled $499.8 million or about 5 percent, while work with other government agencies totaled about 8 percent or $734.6 million. $55.9 million, or one percent was spent outside the U.S. with Canada receiving the major share.

Spending with Social Responsibility

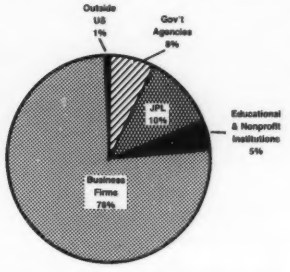
NASA encourages procurement from small businesses to spread economic benefit across a wide cross section of our society. Small businesses received 11 percent, or over $800 million in awards last year, including over $172 million awarded to small disadvantaged firms under section 8(a) of the Small Business Act and over $47 million awarded through the Small Business Innovation Research Program.

Small business set-asides constituted 41 percent of the total awards to small business or about $326 million. There are competitive awards limited to small business.

U.S. Geographical Distribution of NASA Prime Contract Awards — FY 1988 (millions of dollars)

Where Do We Spend the Money?

In FY 1988, 50 states and the District of Columbia participated in NASA's direct awards over $25,000. These larger awards were distributed among 8,969 contracts



Awards by Type of Contractor — FY 1988

and went to 2,412 different organizations in 860 cities. 410 educational and nonprofit institutions located in 272 cities in 50 states and the District of Columbia received such awards.

Employees interested in obtaining the FY 1988 Annual Procurement Report which reviews that year's procurement activities in detail should address their request to NASA, Office of Procurement (Code HM), Washington, D.C. 20546. ■

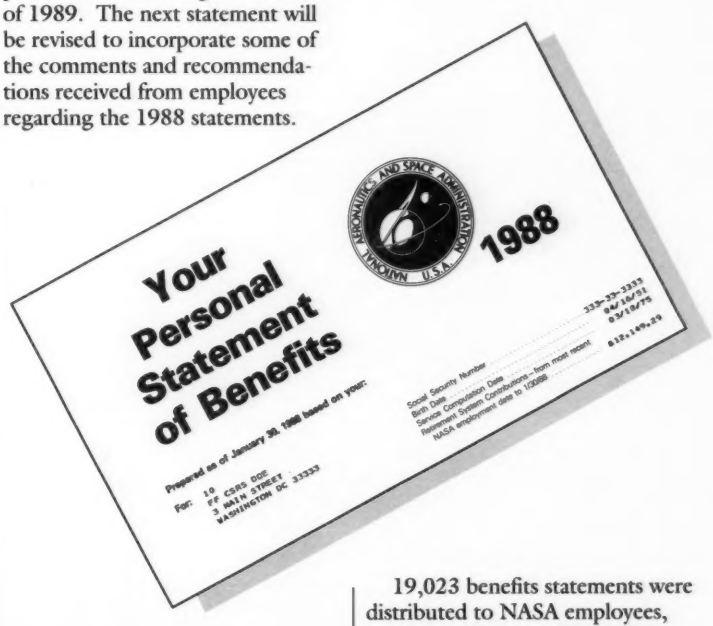
*Excludes smaller procurements, generally those of $25,000 or less; also excluded, awards placed through other government agencies, awards outside the U.S., and awards on the JPL contracts.

Statement of Benefits: Concise and a Time Saver

For some time, NASA explored ways to provide a document that summarized employee benefits in one publication. Without such a document, employees must ask the Personnel Office for the details of benefits coverage, research a multitude of written sources and documentation, and dig up different plan documents. Information gained this way is usually verbal, with no documentation to take home for future reference.

The first NASA Employee Benefits Statements were distributed last September and there are plans to issue them again in the Fall of 1989. The next statement will be revised to incorporate some of the comments and recommendations received from employees regarding the 1988 statements.

Another comment received from employees involved the time lag between the data and the distribution of the statement. Last year, one of the most time-consuming projects incuded transferring current personnel and payroll data into codes which could be manipulated by the contractor who produced the statements. Since most of the employee data fields will remain the same this year, there should be a reduction in the amount of time between the employee data submission and the benefits statement.


Your Personal Statement of Benefits
1988
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION U.S.A.
Prepared as of January 30, 1988 based on you:
For: JO
FF CSRS DOC
2 MAIN STREET
WASHINGTON DC 33333
Social Security Number 333-33-3333
Birth Date 04/16/51
Service Computation Date 03/18/75
Retirement System Contributions—from most recent
NASA employment date to 1/30/88 $10,149.29

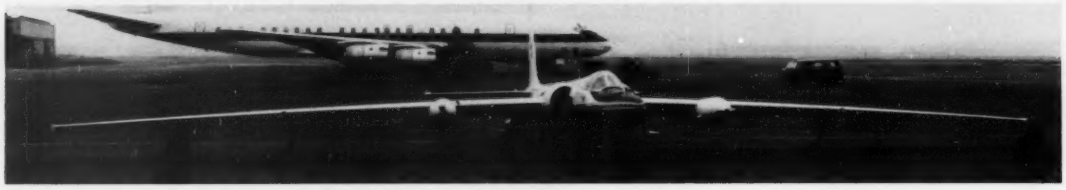
Modifications will improve benefits statement.

The 1989 statement will include retirement annuity estimates for employees who are elegible for retirement within five years. These estimates will be based on the employee's current service computation date and current salary.

19,023 benefits statements were distributed to NASA employees, excluding those at Johnson Space Center. 25 percent of the employees returned the survey with their comments on the statements. The majority of those who responded felt the statement text was clear and generally easy to understand, and the information on employee benefits (health, disability, death, and retirement) was satisfactory. ■

AGENCY HIGHLIGHTS

Arctic Ozone: Preliminary Findings from Stavanger



Polar Air Primed for Ozone Destruction

By Charles R. Redmond, Hq

Two days after the conclusion of the Airborne Arctic Stratospheric Expedition, the top two scientists in charge of the mission reported on their preliminary scientific findings. The news was not good.

Drs. Robert Watson, NASA Headquarters chief of upper atmospheric research and tropospheric chemistry, and Adrian Tuck, NOAA Aeronomy Lab chief of physics and chemistry, told heads of other agencies, reporters, and Hill committee members and Congressmen that the Arctic region was primed for the same type of ozone depletion as had been found the previous year in the Antarctic.

The key findings of the 1989 Airborne Arctic Stratospheric Expedition were that the chemical composition of the Arctic polar stratosphere was found to be highly perturbed.

The observed abundance of the ozone-depleting chlorine monoxide radical (ClO) was elevated by up to a factor of 50 in the Arctic lower stratosphere; the abundance of chlorine dioxide (OClO) was increased by up to a factor of 50; the abundance of the major inactive chlorine reservoir, hydrochloric acid (HCl), was considerably reduced, indicating that there had been a conversion from the inactive to the active (ozone-depleting) chemical forms of chlorine; and the abundances of nitric oxide (NO) and nitrogen dioxide (NO2) were significantly reduced, thereby preventing the reconversion of ClO into an inactive form of chlorine.

The measurements of several of the above compounds indicate that these perturbations occur over a wide range of altitudes in the stratosphere in the Arctic region.

The above observations add up to a consistent picture that is similar to the one drawn from the Antarctic data in 1987 and are believed to be the result of chemical reactions occurring on polar stratospheric clouds that form at the cold temperatures in the polar regions.

If there is any good news in these findings it is that the scientists could find no unequivocal signature of a photochemical loss of Arctic ozone before the end of this mission. However, by the end of the mission on February 15, a considerable portion of the circulating polar air was primed for ozone destruction.

The scientific team found it difficult to predict the degree of Arctic ozone depletion that would actually occur because it depends on several factors including the rate of renormalization of the chlorine, the degree to which the Arctic polar air stays separated from the rest of the atmosphere and the amount of sunlight reaching the confined polar air.

Despite all these conditions, the Arctic atmosphere team determined that the relevant meteo-

NASA's DC-8 flying atmospheric research laboratory and ER-2 at Stavanger, Norway, following a research flight.

Aboard NASA's DC-8, scientists observe ozone data being taken as the atmospheric research plane

rological conditions for the formation of the polar stratospheric clounds in the Arctic polar region were not unusual this year. Hence, the phenomena observed are expected to occur in most years.

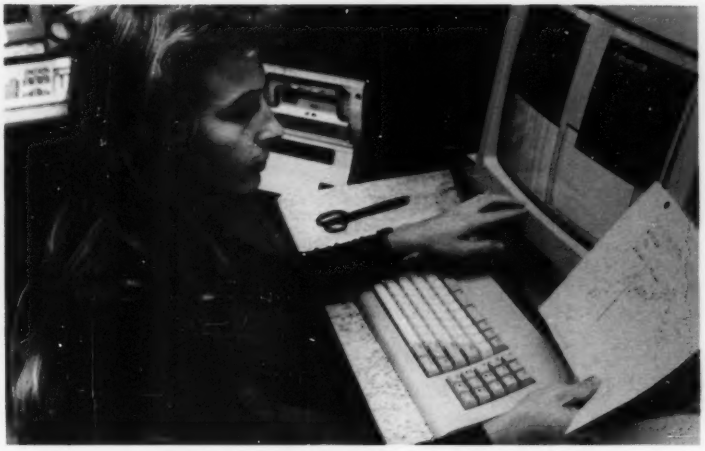
The scientists note that the observed polar stratospheric cloud-induced buildup of reactive chlorine compounds represents an additional ozone-depleting process that was not included in the stratospheric ozone assessment models used as a basis for the Montreal Protocol.

Followup Studies

When the scientists concluded their mission they were concerned that man-made chlorine and bromine containing chemicals had the potential to destroy ozone in the polar regions. The rate of destruction and the overall atmospheric effect will be part of follow-up studies to be performed on the Arctic ozone data the remainder of this year. The scientific team expects to be able to provide their results by this Fall.

This Airborne Arctic Stratospheric Expedition was similar to the one based in Punta Arenas except that it was performed in the middle of winter rather than in late winter / early spring. The campaign utilized two aircraft, an Ames Research Center high altitude ER-2 and the ARC modified DC-8. Both planes and the scientific team were based at Sola Airfield near Stavanger, Norway (59 degrees N latitude , 6 degrees E longitude) from January 1 to February 15, 1989. These aircraft were equipped with state-of- the-art instrumentation (13 instruments on the ER-2, and 10 on the DC-8) for determining the chemical composition and physical state of the atmosphere.

Satellite and ground-based measurements were also incorporated into the data and became integral components of the campaign. Teams of theorists participated with the experimentalists in flight planning and in the interpretation of the data. There were 14 flights of the DC-8 and 14 flights of the ER-2, excluding the ferry flights between the USA and Norway. DC- 8 flights went as far north as the Pole and as far west as the western coast of Greenland. The ER-2 ranged as far as 82 degrees N latitude and the center of Greenland.



Leslie Lowes, NASA Jet Propulsion Laboratory, reviews data acquired with the JPL interferometer experiment, which flys on the DC-8 flying laboratory. The experiment uses optical means to measure ozone remotely.

flies a mission. This instrument uses a laser to measure ozone abundances.

International Scope

In addition to NASA and NOAA scientists, managers, aircraft pilots and crew, scientists and technicians from the National Science Foundation's National Center for Atmospheric Research, the United Kingdom Meteorological Office, the U.K. Department of Environment, the University of Oslo, and the Norwegian Meteorological Office participated in the project. Additional data were supplied by West German, Danish and Soviet balloon sounding teams located throughout the Arctic region.

The project was managed by NASA and funded and supervised out of the Office of Space Science and Applications Earth Science and Applications Division, Washington. It was the largest real-time scientific expedition yet staged by NASA or any other organization and involved more than 300 individuals with more than 200 located at Stavanger, Norway. ■

STS-29: Completion of the TDRSS Constellation

The STS-29 Crew

from left to right

Michael L. Coats, Captain, USN, Mission Commander. Coats was Pilot of the 14th Space Shuttle mission (41-D), Discovery's maiden flight which launched a record three communications satellites. Coats has logged more than 144 hours in space prior to this mission and has 4,700 hours of flying time, including 400 carrier landings in 22 different types of aircraft.

James F. Buchli, Colonel, USMC, STS-29 Mission Specialist 1. Member of the astronaut class of 1978, Buchli was a mission specialist on STS 51-C, a Department of Defense mission in 1985. He also was a mission specialist on STS 61-A, the West German Spacelab D1 mission. Buchli has logged 243 hours in space and 3,500 hours of flight time.

John E. Blaha, Colonel, USAF, is Pilot for STS-29. A member of the astronaut class of 1980, Blaha has been an ascent, orbit, planning and entry capsule communicator (CAPCOM) in Mission Control for seven Shuttle flights. He was lead CAPCOM for STS-41-D and 41-G.

James P. Bagian, M.D., is Mission Specialist 3 for STS-29. A member of the astronaut class of 1980, he participated in the planning and provision of emergency medical and rescue support for the first six Shuttle flights. He was an investigator for the 51-L accident board.

Robert C. Springer, Colonel, USMC, is STS-29 Mission Specialist 2. A member of the astronaut class of 1980, he has served as CAPCOM for seven Shuttle flights. Springer has been responsible for the Astronaut Office coordination of design requirements and certification reviews for STS-26's return to flight. He has logged more than 3,500 hours of flying time.

Heroic Efforts Mark Preparations

Preparing the Space Shuttle Discovery for launch on mission STS-29, required an almost "herculean" effort on the part of hundreds of managers, engineers and technicians throughout NASA.

Because of tiny stress corrosion cracks discovered in a main engine pump on the orbiter Atlantis after its flight last December, NASA officials decided to replace all three oxygen turbopumps on Discovery.

Shuttle managers decided to move Discovery to the launch pad for the pump change-out work because of the need to clear the way for the orbiter Atlantis, which will deploy the Magellan Venus radar mapper during its flight next month.

The process was far from easy. Once Rocketdyne assembled the new pumps, they had to be shipped to the Stennis Space Flight Center for "hot fire testing." Then on to Kennedy Space Center, where engineers and technicians, working in the cramped confines of Discovery's engine compartment, fitted the pumps to the three main engines.

Literally working around the clock, the NASA team completed the pump changeout in less than three weeks.

The Mission

Deployment of the third Tracking and Data Relay Satellite (TDRS-D) highlights the 28th Space Shuttle mission (STS- 29).

Three TDRS, operating from geosynchronous orbit, are required to complete the constellation known as the Tracking and Data Relay Satellite System (TDRSS). TDRSS will increase communications, between Earth-orbiting spacecraft and a ground-based tracking station, from 15 to 85 percent per orbit and facilitate a much higher rate of data flow.

TDRS-C was successfully deployed on STS-26 in September 1988 and is located in geosynchronous orbit at 171 degrees W. longitude, south of Hawaii. TDRS-D will be located at 41 degrees W. longitude, east of Brazil. TDRS-A, deployed on STS-6 in April 1983, then will be moved to a parking orbit and used only if a failure occurs with one of the remaining two satellites.

With deployment some 6 hours into the mission on flight day one, an Air Force-developed inertial upper stage (IUS) boosts the TDRS to geosynchronous orbit (22,300 miles above Earth) after ejection from the Shuttle.

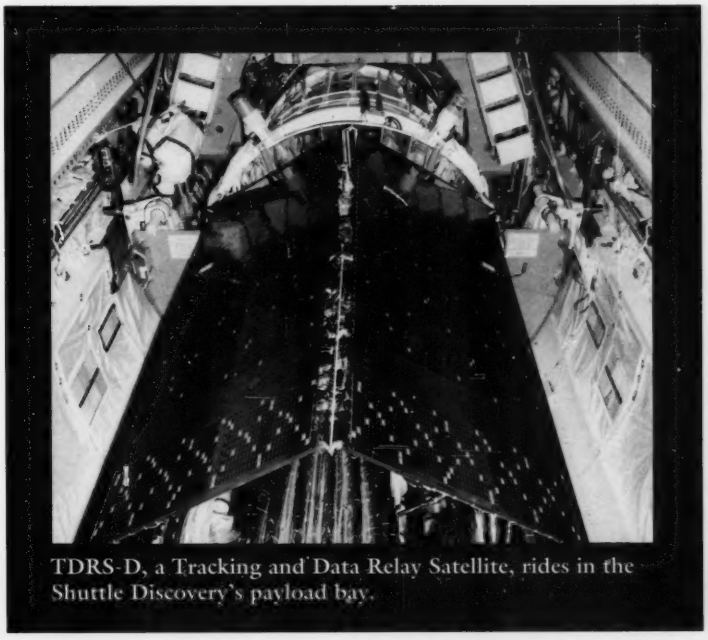
The three-axis, stabilized upper stage maneuvers TDRS to the desired attitude where it is configured for operation by the NASA White Sands Ground Terminal, N.M.

CONTEL, Atlanta, Ga., owns and operates the TDRSS for NASA. TRW's Defense and Space Systems Group, Redondo Beach, Calif., builds the satellites.

The Orbiter Experiments Program Autonomous Supporting Instrumentation System (OASIS) on board STS-29 records environmental data in the orbiter payload bay during flight phases. OASIS measures TDRS vibration, strain, acoustics and temperature during launch ascent using transducers affixed directly to the payload.

In addition to TDRS-D and OASIS, Discovery carries the Space Station Heat Pipe Advanced Radiator Element (SHARE) in the payload bay. Several secondary payloads will be carried in the middeck of Discovery, including the IMAX camera, two student experiments, a protein crystal growth experiment and a chromosome and plant cell division experiment.

After landing, deservicing and ferry back to Kennedy Space Center, Discovery will begin processing for its next flight scheduled for August. ■



TDRS-D, a Tracking and Data Relay Satellite, rides in the Shuttle Discovery's payload bay.

STS-29 Secondary Payloads

Space Station Heat Pipe Advanced Radiator Element (SHARE)

The goal of the experiment is to test a first-of-its-kind method for a potential cooling system of Space Station Freedom. See more about the SHARE experiment in "Center Highlights," page 13.

Chromex

This experiment will determine whether the roots of a plant in microgravity will develop similarly to those on Earth. Root- free shoots of the plants daylily and haplopappus will be used. The experiment will determine whether:

- The normal rate, frequency and patterning of cell division in the root tops can be sustained in space.
- The chromosomes and genetic makeup is maintained during and after exposure to space flight conditions.
- Aseptically grown tissue cultured materials will grow and differentiate normally in space.

Protein Crystal Growth

A team of industry, university and government researchers will explore the potential advantages of using protein crystals grown in space to determine the complex, three-dimensional structure of specific protein molecules.

Knowing the precise structure of these complex molecules provides the key to understanding their biological function and could lead to methods of altering or controlling the function in ways that

continued on page 10

Secondary Payloads
from page 9

may result in new drugs.

During the flight, 60 different crystal growth experiments will be conducted simultaneously using 19 different proteins.

Chicken Embryo Development in Space

Proposed by John C. Vellinger, formerly of Jefferson High School, Lafayette, Ind., this experiment is to determine the effects of spaceflight on the development of fertilized chicken embryos.

The experiment flys 32 chicken eggs—16 fertilized two days prior to launch and the other 16 fertilized 9 days prior to launch — to see if any changes in the developing embryo can be attributed to weightlessness.

An identical group of 32 eggs will remain on Earth as a control group.

Postflight examination of half of the eggs is intended to identify any statistically significant differences in cartilage, bone and digit structures, muscle system, nervous system, facial structure and internal organs. The other half of the eggs (16 spaceflight and 16 control) will be hatched at 21 days and their weight, growth rate and reproductive rate will be studied.

The Effects of Weightlessness on the Healing Bone

An experiment proposed by Andrew I. Fras, formerly of Binghamton High School, N.Y., to establish whether the environmental effects of spaceflight inhibit bone healing.

Observations of rats from previous space flights, as well as non-weight bearing bone studies in gravity using rats, have shown that minerals, calcium in particular, are lost from the body, resulting in a condition similar to osteoporosis. Calcium is the main mineral needed in bone formation. This experiment will fly four Long Evans rats where a minutely small piece of bone will be removed by a veterinarian from a non-weight bearing bone. The effects of weightlessness on the origin, development and differentiation of the osteoblasts (bone cells) and their production of callus will be studied. A matched control group will be Earth-based.

The Joe Montana of the Astronaut Office, STS-27 Commander, Robert "Hoot" Gibson (left), demonstrates a quarterback form that contributed to a "record" 2 billion, 992 million yard "kick off and return." the longest in history. The official NFL football was "kicked" into low Earth orbit from Kennedy Space Center, December 2, 1988 and "carried" by the crew of the Atlantis. "Touchdown" was at Edwards AFB, December 6, 1988. "Receiving" during Superbowl XXIII halftime activities, is National Football League Commissioner Pete Rozelle (3rd right), "flanked" by STS-27 crew members (l to r) Mike Mullane, Guy Gardner, Jerry Ross and William Shepherd.

IMAX

The IMAX project is a collaboration between NASA and the Smithsonian Institution's National Air and Space Museum to document significant space activities using the IMAX film medium. This system, developed by the IMAX Systems Corp., Toronto, Canada, uses specially-designed 70mm film cameras and projectors to record and display very high definition large-screen color motion picture images.

Air Force Maui Optical Site Calibration Test

The Air Force Maui Optical Site (AMOS) tests allow ground-based electro-optical sensors located on Mt. Haleakala, Maui, Hawaii, to collect imagery and signature data of the orbiter during cooperative overflights.

Orbiter Experiments Autonomous Supporting Instrumentation

Special instrumentation to record the environment experienced by Discovery during the STS-29 mission is mounted in the orbiter payload bay.

Called OASIS, the instrumentation is designed to collect and record a variety of environmental measurements during various in-flight phases of the orbiter. ■

Orbital Debris Study Completed

The U.S. government has released results of a six month interagency study on orbital debris.

The study, co-chaired by NASA and the Department of Defense, cites satellite and rocket body fragmentation as the principal source of orbital debris and concludes that, left unchecked, the growth of debris could threaten the safe and reliable operation of manned and unmanned spacecraft in the next century.

A major finding concerns the limits of knowledge about the current population of orbital debris objects. While the U.S. Space Command routinely tracks objects in space that are larger than a softball (about 10 centimeters and larger), the ability to track smaller objects is hampered by system design. The uncertainity, therefore, as to exactly how much debris is in orbit makes it difficult to assess the true risk posed to spacecraft. This, in turn, creates uncertainity as to the urgency for action and the potential effectiveness of any corrective action. The report says that the need for enhancing debris measurement capabilities "has been universally recognized." ■

NASA Announces Program For a Drug-Free Workplace

NASA Administrator Dr. James C. Fletcher has announced that in support of an executive order calling for a "Drug-Free Federal Workplace," the agency will implement a broad-based program.

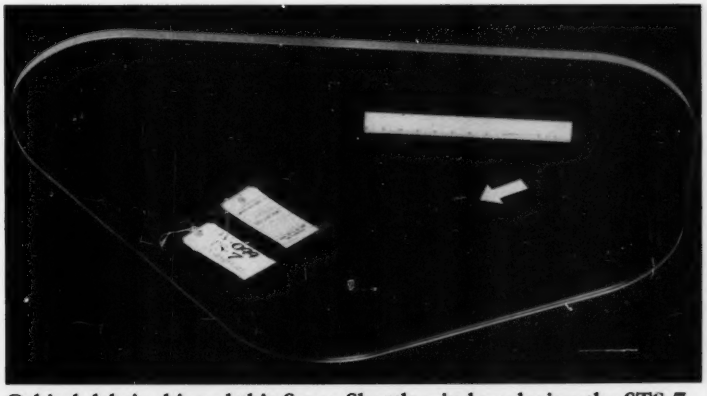
Fletcher stressed that the NASA program considers "the unique nature of its work force and the limited scope of drug abuse in the agency." Consequently, the program strongly emphasizes education, training and assistance through the NASA Employee Assistance Program (EAP), coupled with a limited degree of drug testing, as the most effective means of ensuring a continuing drug-free workplace.

"NASA recognizes that drug abuse is debilitating and that prolonged illegal drug use makes it progressively more difficult for the individual to refrain from such drug use. NASA will continue to extend a helping hand to any employee who may be experiencing a problem related to such drug use by encouraging the employee to take advantage of the existing services provided by the NASA EAP," Fletcher said in a letter to all NASA employees.

Fletcher said that employees who occupy "sensitive" positions, as defined in the NASA program and determined by NASA management, will be subject to random drug testing. Included among the agency's sensitive positions are: all senior level management personnel, including the administrator and his deputy, as well as all center directors; flight-related personnel such as astronauts, pilots, mission and payload specialists, flight controllers, test directors and other scientific and engineering personnel involved in the actual planning and managing of manned and unmanned flight related activities; research personnel such as scientists, engineers, technicians and mechanics; and safety-related personnel such as criminal investigators, firefighters and quality assurance specialists.

> Program considers the unique nature of NASA's workforce...

Fletcher also said that, while drug testing may be required if there is a reasonable suspicion of illegal drug use or an accident or unsafe practice, all drug testing will be conducted in accordance with the mandatory guidelines for federal workplace drug testing programs issued by the Department of Health and Human Services. ■



Orbital debris chipped this Space Shuttle window during the STS-7 mission. The chip was approximately .2 inch in diameter.

Goddard Receives NASA Equal Opportunity Trophy

NASA Administrator James C. Fletcher (left) presents the Equal Opportunity Trophy plaque to Goddard Director John Townsend, Jr.

Goddard Space Flight Center (GSFC) has been selected from among four NASA installations to received the FY 1988 Equal Opportunity Trophy (EO) Award. As recipient, GSFC became the first NASA center to be awarded the trophy three times (1980 and 1986).

The annual award of the EO trophy recognizes and rewards the installation and management team members who have worked to implement the most effective management approach and have achieved the most positive affirmative action results during the one year period.

During FY 1988, GSFC managers provided leadership that resulted in the greatest net change among all target groups in the science and engineering (S & E) skill codes, the largest managerial and supervisory gains in the S & E and technician occupations, the employment of Hispanic professional administrative employees and the largest amount and highest percentage of dollars awarded to minority business.

Additionally, GSFC continued its strong support of the NASA/Spelman College Women in S & E Scholars program, and ensured the participation of minority and female faculty in the NASA Summer Faculty Fellowship program.

GSFC also instituted two programs that serve as models for other NASA installations. One initiative was the internship program for students with disabilities, which included seminars for supervisors on how to supervise employees with hearing disabilities. The other initiative was a training course, "Managing Age Diversity in a Contemporary Organization," which was designed to identify concerns and past experiences, and to develop strategies for working with employee groups where there is a great diversity in age.

The trophy commends GSFC and it's management team for their exemplary contributions to the agency's efforts to have a respresentative workforce, to provide all employees with the opportunity to contribute their best talent to the agency's missions, and to share NASA's research grants and procurement contracts with a broader array of the Nation's citizenry. ■

Cosmos Mission Results and Future U.S./USSR Missions Announced

The science results of the collaborative U.S./USSR biosatellite mission from Cosmos 1887 have confirmed the adverse physiological and biomedical effects of prolonged space flight.

The analyzed mammalian biospecimens suggest that adolescent vertebrate animals will experience significant alterations in calcium metabolism, immune functions and musculoskeletal mass and structure.

The Soviet Union launched Cosmos 1887 on Sept. 29, 1987, for a 12 plus day mission. Cosmos 1887 was the sixth in a series of unmanned Soviet satellites that flew U.S. and USSR life science experiments.

The U.S. experiments on Cosmos 1887 investigated the effects of space flight on the major body systems, including skeletal bones and muscles, nervous system, heart, liver and several glands and blood. Special tissue culture studies, using pituitary cells, studied the growth hormone. Spleen and bone marrow cells were used to investigate the effects of microgravity on the immune system.

The USSR provided the U.S. tissue samples from 5 to 10 rats that were flown aboard the spacecraft.

The science results of Cosmos 1887 bone studies indicated structural changes occurred without significant changes in the mineral content. For example, the bending strength of the rat humerus bone was descreased by 40 percent and the compression

continued on page 15

CENTER HIGHLIGHTS

SHARE: Ammonia-Powered 'Air Conditioner' Gets Flight Test On STS-29

By James Hartsfield, JSC

After a decade of development at JSC, an innovative system that could become Space Station Freedom's "air conditioner" rides on one side of Discovery's payload bay on STS-29.

The Space Station Heat pipe Advanced Radiator Element (SHARE) flight experiment, mounted on the starboard sill of the Orbiter's payload bay, tests whether a natural process can serve as a dependable, durable cooling system for America's permanent space station, said Principal Investigator Gary Rankin.

Unimpressive in its outward appearance—it looks somewhat like a slat from a giant venetian blind—the heat pipe uses no moving parts, working instead through the surface tension of ammonia. Heat pipe systems have cooled satellites, but have never before been applied to manned spacecraft.

The SHARE hardware includes two small "pipes" bored through an aluminum core that runs through the center of a 51-foot-long, foot-wide radiator. The two pipes, one slightly larger than the other, are connected by a very narrow slot. On one end is an evaporator where the pipes branch out like fork tines.

During the orbital test, three electric heaters warm the evaporator end of SHARE. In the evaporator, a fine wire-mesh wick that works along the same principle as the wick of an oil lamp pulls liquid ammonia from the smaller pipe into the larger pipe, where it is vaporized by the heat. The vapor carries the heat the length of the radiator through the larger vapor pipe. The radiator dissipates the heat into space, leaving cooled, condensed ammonia. Small circumferential grooves on the wall of the larger pipe allow condensed ammonia to drop back through the narrow slot into the smaller pipe, which recirculates the liquid ammonia back to the evaporator.

Cross section of SHARE radiator is displayed by JSC engineers Jerry Woodfill (left) and Steve Glen.

Rankin has worked with heat pipe development at JSC for 10 years, and SHARE is a result. During those 10 years of work, more than 200 JSC workers have contributed to what has now become SHARE, Rankin said.

"It would really be impossible to name everyone at JSC who has had a part in SHARE," Rankin said. "Through the years, it has been almost totally an in-house project of the center, a large team effort."

An early heat pipe experiment flew aboard STS-8 in August 1983. Although it was small in scale, using only a six-foot long radiator, the STS-8 experiment operated successfully for two hours and demonstrated the concept's potential.

A full-scale radiator element then was built and tested in thermal environments at JSC in 1984, Rankin said. The SHARE flight experiment took shape later that year and was scheduled to fly in 1986. But the two-and-a-half-year halt in Shuttle flights delayed the experiment. Said Rankin, "We want to demonstrate the generic capability of this family of heat pipes. We have very high confidence that the basic concept for the space station system is a viable one."

"The goal is to simulate the heat that will need to be dissipated from the space station," Rankin explained.

For the space station, 50 to 100 radiator panels such as SHARE's would make up two arrays along the station's truss structure. Each radiator panel will operate independently, thus preventing the failure of a single panel from disabling an entire array. ■

Truck Aerodynamic Device Could Lead to Major Fuel Savings

Major improvements in the fuel economy of U.S. tractor trailer trucks could result from a new device, called an aerodynamic boat tail, recently tested in a wind tunnel at NASA's Ames Research Center.

Estimates based on U.S. Department of Transportation data for fuel consumption by tractor trailer trucks indicate the savings could reach nearly one billion gallons of fuel per year if the device were widely used by the U.S. trucking industry.

The aerodynamic boat tail consists of plate extensions attached to the rear of the trailer. "The testing showed that the boat tail plates decreased air drag by about 10 percent on a current, aerodynamically clean, tractor trailer," said Dr. Jim Ross, Ames project director.

The simplicity of the device means that it can be readily retrofitted to existing trailers and will not severely interfere with the operations of the rear door.

Drag reduction is achieved by causing the air flowing over the trailer's top and sides to turn inward as the air separates at the trailer's back. The plates cause the air to behave as if there was a tapered faring, or "boat-tail," on the back of the trailer.

The air flow is turned in a region where the flow is trapped by the plates. By turning the flow, pressure on the back of the truck is increased and the drag is reduced.

Testing at NASA's Dryden Flight Research Facility in the early 1980's showed significant drag reduction on ground transportation vehicles using boat-tail devices, rounded corners and enclosed underbodies. Tests in the mid-70's showed the effectiveness of adding flow-directing devices above the cab to reduce drag, a feature widely adopted by U.S. truckers. ■

Tests in a NASA Ames Research Center wind tunnel indicate that the aerodynamic boat-tail device, shown in this picture as plate extensions on the rear of the trailer, reduced average drag by 10 percent.

Effects of Clouds on Climate Measured by NASA Project

The disputed effects of clouds on the Earth's temperature has been resolved by NASA's Earth Radiation Budget Experiment (ERBE) satellite.

The most accurate Earth radiation budget measurements ever made, provided by ERBE, confirm that clouds result in a net cooling of the Earth.

These measurements serve as the baseline for climate modelers to determine whether clouds will partially offset or enhance a future warming of the Earth due to the greenhouse effect.

The major uncertainty in the current ability to assess the future impact of greenhouse gases is the effect of clouds. ERBE has given climate modelers some very specific numbers to test and validate their models.

At any given time, clouds cover about 60 percent of the Earth. Wispy, high-altitude cirrus (ice) clouds generally tend to warm the surface. They reflect less solar energy back to space than stratus and cumulus (liquid water) clouds.

Because they are so high in the atmosphere, ice clouds are more efficient at trapping the infrared heat energy emitted by the Earth and the atmosphere. Low-level water clouds not only shade the Earth's surface from the Sun's rays better than high- altitude ice clouds, they emit almost as much infrared radiation as a cloud-free Earth. The net effect of clouds on surface temperatures depends on how these different cloud types are distributed over the globe.

The first of the three ERBE satellites was launched by the Space Shuttle Challenger in October 1984. National Oceanic and Atmospheric Administration

continued on page 16

Cosmos
from page 12

strength of the lumbar vertebra was decreased by 27 percent.

Muscle studies on the rats showed that, while individual muscle weights were similar for both flight and ground control animal groups, the fast muscle types showed significant decrease in cross sectional area, atrophy and extracellular edema, while at the same time showing increased necrotic fibers and motor end plate degradation. Slow muscle types showed little evidence of atrophy but some biochemical changes. The mitochondria in the heart muscle also showed degeneration and fiber changes.

Observations on other body organs and physiological systems confirmed what was learned on previous flight research experiments, such as a decreased mass and spermatogenesis in the testes, decreased growth hormone release by the anterior pituitary cells, increased cholesterol, triglycerides and organ weight in the liver and a reduced immune response suggested by several types of measures involving the spleen, bone marrow and blood.

The U.S. has three opportunities to fly experiments with the Soviets in the next few years. The USSR has invited the U.S. to participate on the USSR 1989 and 1991 biosatellite missions.

The science focus will be in biomedical research with the following payload specimens: Rhesus monkeys, male wistar rats, fish, fish eggs, newts, drosophila, beetles, seeds, unicellular organism and planaria.

In reciprocal fashion, Soviet scientists have been invited to participate in analysis of specimens from the U.S. Shuttle Spacelab life sciences mission to be launched in June 1990. ■

OMB Announces Lewis Winner of Quality Improvement Prototype Award

The Office of Management and Budget (OMB) has announced NASA's Lewis Research Center as winner of the 1989 Quality Improvement Prototype Award. The award is part of the President's Productivity Improvement Program for the Federal Government, which is administered by OMB.

Lewis was one of six Federal Government organizations to win this distinction, and is the first research and development facility so honored. NASA's Johnson Space Center was also a finalist during the selection process.

Lewis Research Center advanced turboprop team member Al Matthews, is congratulated by Dr. John Klineberg, center director, for a job well done. Nearly 450 civil service and contractor employees were honored at the AWARENESS Team Recognition. The AWARENESS program was cited as an important factor is Lewis' selection as a Quality Improvement Prototype.

In announcing the selection OMB Director Joseph Wright stated that, "a prototype organization demonstrates an extraordinary commitment ot quality improvement, focuses attention on satisfying its customers, and establishes high standards of quality, timeliness and efficiency. This kind of organization also serves as a model for the rest of government—showing how a commitment to quality leads to better and more efficient services and products for its customers."

The Lewis Research Center is cited for implementing a quality improvement process that focuses on team involvement and customer satisfaction as central priorities. Throught this process the Center has brought improved quality and efficiency to research and technological developments in aircraft propulsion, space propulsion and space power. Additional factors specified were increases in disclosures of inventions and publications, receipt of numerous awards for technical contributions in recent years, including the1987 Collier Trophy, and other improvements such as a 54 percent reduction in the processing time for technical papers.

A government-wide Quality and Productivity Improvement conference will be held on May 31 through June 2 at Tyson's Corner, Fairfax County, Va., to recognize these awards. ■

Q&A

The following questions and answers are excerpted from interviews conducted for NASA's radio program, "The Space Story."

Artificial Gravity

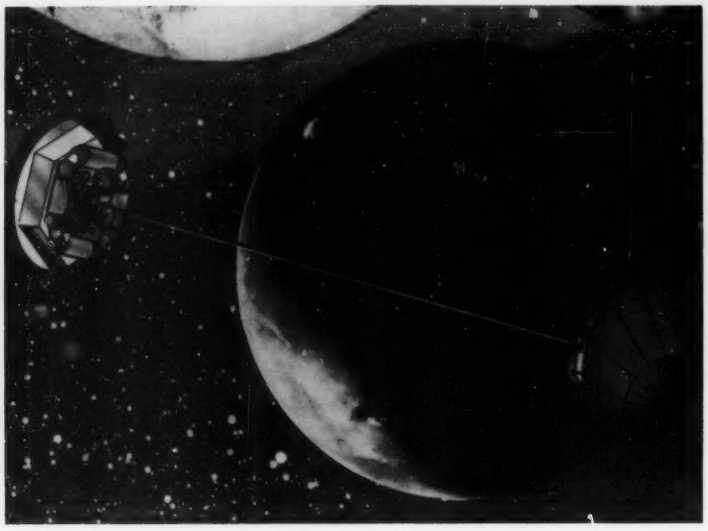
Artificial flavors, artificial respiration, artifical intelligence — all of these are now practically everyday expressions. In plotting trajectories for human voyages beyond Earth's boundaries, a new term may become commonplace: "artificial gravity." To counter the negative effects of long-term weightlessness on the human body, space planners are developing countermeasures such as artificial gravity.

Q What are some of the maladies long-term space travelers have to deal with?

A Larry Lemke of NASA's Office of Exploration details some of these problems: "Briefly, those problems are such things as loss of calcium from the bones, muscle loss, and changes in the muscle structure, cardiovascular deconditioning, anemia or loss of red blood cells, and possible deterioration of the immune systems. All of these factors have been observed in various manned space flight projects, both by ourselves and the Soviet Union."

Q What solutions might be applied in order to combat these effects?

A "One approach," says Lemke, "is a device that would fit inside of the habitat...like a big spin dryer/washing machine. One could get in this device for a few hours every day and subject themselves to some level of artificial gravity and perhaps do exercise simultanously and then turn the machine off and go about their regular duties in zero-G. Another concept, which is perhaps more ambitious, is to place the entire habitat in artificial gravity, and in that case, it would be perceived probably very much like the "Star Trek" and other science fiction depictions. To all appearances, a person in that habitat would almost be unable to tell the difference between their artificial gravity level and planetary gravity."



"Cable/counterweight" concept for artificial gravity on a long space voyage.

Q What would a marsbound habitat look like to mimic the necessary gravity forces?

A Lemke speculates: "...the only way to produce that is by rotating the habitat around in a circle...probably a very large radius of about a half-a-mile or so, and the only way to do that is with a cable connecting the habitat to a counterweight on the other end. The whole device would be spinning as it makes its way between Earth and Mars." ■

Climate

from page 14

(NOAA) weather satellites NOAA-9 and NOAA-10 launched in December 1984 and September 1986, respectively, also carried the ERBE instruments. ERBE provided the first opportunity to measure the three components of the Earth's radiation balance with identical instruments flying simultaneously on separate satellites.

ERBE is the first step in NASA's long-term program for studying climate change and is both a national and international effort supported by other government agencies and universities.

The ERBE satellite instruments were developed at Langley and the TRW Corporation, Redondo Beach, Calif. Langley is responsible for data analysis. ERBE was developed at NASA's Goddard Space Flight Center, Greenbelt, Md., and Ball Aerospace, Boulder, Colo. NOAA supplied the two weather satellites. ■

CONGRESSIONAL CORNER

Committee Assignments for the 101st Congress

The Congressional Corner is written by the Congressional Relations Officer.

HOUSE OF REPRESENTATIVES

("*" indicates freshman member, new to committee. "**" indicates senior member, new to committee.)

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continued on page 20

NASA NEWS CAPSULES

News Capsules are NASA news releases edited by the Internal Communications Branch, Office of Communications.

Atmospheric Sounder for EOS Space Platform Selected

NASA's Jet Propulsion Laboratory (JPL), has established a new scientific instrument project office to develop and design a major new system for observing Earth's atmosphere. Scientists expect it to support a quantum leap in weather forecasting and in understanding our climate.

The instrument, called the Atmospheric Infrared Sounder (AIRS), was selected by NASA in late November 1988 to ride aboard the Earth Observing System (EOS) polar orbiting platform, as a facility instrument, beginning in the 1990s. This platform is an element of NASA's Space Station Freedom and proposed "Mission to Planet Earth" programs. EOS also is one of several Earth orbiting scientific platforms planned by the U.S. and other nations.

The AIRS system will provide global, three dimensional information on the temperature and composition distributions in the atmosphere as well as climate related properties of the sea and land. It also will mealsure and help map ozone and various other "greenhouse" gases. AIRS will observe both day and night.

The value of AIRS will be the continous long term record it compiles of climate change. "We can see and measure changes in global temperature over periods of one or more solar cycles," says Dr. Moustafa Chahine, JPL's chief scientist. "We will have records of trends in the greenhouse effect, both in the composition and movement of gases which cause it and in regional patterns of moisture and air circulation which may result from it. These are long term changes, in contrast to weather patterns and are very subtle."

AIRS is similar in some respects to the ATMOS experiment flown aboard a Shuttle flight in the spring of 1985 and planned for another Shuttle mission as part of the Atlas 1 mission. There are differences in the two systems in their resolutions and in the length of their observing periods. "ATMOS can observe the makeup of the upper atmosphere better than AIRS for a short period, but only AIRS can stay at its post observing changes year in and year out," says project manager Fred O'Callaghan, who is in charge of both efforts at JPL. "With refurbishments, we hope to get 15 years or more out of the AIRS instrument." ■

NASA AND NIH Appoint Interagency Working Group Members

NASA's Dr. Lennard Fisk, associate administrator of the Office of Space Science and Applications, and Dr. James Wyngaarden, Director of the National Institutes of Health (NIH), appointed a panel to explore a variety of cooperative and complementary programs in biomedical research.

Chairman of the group is Dr. Arnauld E. Nicogossian, M.D., NASA's director of the Life Sciences Division; co-chairman is Dr. Jay Moskowitz, associate director for Science Policy and Legislation, NIH. Other NASA members include: Dr. Ronald White, Dr. Frank Lemkey, Frank Sulzman, Carolyn Huntoon and Jospeh Sharp. Other NIH members are: Dr. Claude Lenfant, Dr. Murray Goldstein, Dr. Lawrence Shulman and Dr. David Rall. The group also includes Dr. Lyle Bivens of the National Institute of Mental Health.

Joint programs in biomedical research, ground-based and space flight, would investigate the biological changes in living organisms that occur or could occur during or after space flight. Potential applications of such research will be assessed.

The interagency working group is established under a memorandum of understanding between the two agencies, signed in mid-1988. The agreement is intended to enhance the biomedical research capabilities of both agencies.

Working group meetings will be held regularly. ■

Daily Update of NASA Select TV Program Schedule

NASA Select TV program scheduling of Public Affairs events is now being updated daily, Monday through Friday, on the NASA Audio News Service - 202/755-1788.

NASA Select TV (Satcom F2R, transponder 13, 72 degrees west longitude) carries a variety of televised agency activities including news briefings and conferences, Space Shuttle and other major missions and special agency functions. The televised programs originate both from NASA Headquarters and NASA field centers.

The daily TV schedule will follow NASA Headline News, a 90- second news summary, originating from NASA Headquarters. ■

HUMAN FACTORS

Brooks Appointed Acting DAA for Management

Brigadier General Elmer T. Brooks, USAF, Retired, has been named acting deputy associate administrator for Management.

General Brooks joined NASA Headquarters in November 1988 as assistant for special projects, Office of the Administrator after serving as a high technology industry consultant following his retirement from the Air Force.

During his thirty year Air Force career he served as commander of a major missile unit and an Air Force Base. He was a flight control technologist for Gemini and Apollo space missions at NASA's Johnson Space Center.

He served as the military assistant to two Secretaries of Defense, Headquarters U.S. Air Force staff personnel manager, arms control policy-maker and advisor to the Joint Chiefs of Staff, Presidential appointee as Deputy Commissioner of the U.S. - USSR Standing Consultative Commission, and as Assistant Deputy Under Secretarty of Defense for Research and Engineering. ■

Ballhaus Returns to Ames

Dr. William F. Ballhaus, Jr., has returned to NASA's Ames Research Center, resuming his position as center director. Ballhaus had accepted a one-year assignment as acting associate administrator for aeronautics and space technology, NASA Headquarters, which began Feb. 1, 1988. He will continue to serve in this position until a replacement is named.

For the past year, Ballhaus has directed NASA's aeronautics and space research and technology development programs and was responsible for the institutional management of NASA's Ames, Langley and Lewis research centers.

In announcing the reassignment, Dr. James Fletcher, NASA administrator, said, "Bill Ballhaus responded to a call to come to NASA Headquarters for a year during a critical period in the agency's history. I express my sincere appreciation to him and his family for what he has contributed toward getting the nation's space program back on track." ■

Whitlow Named Black Engineer of the Year in Government

Dr. Woodrow Whitlow Jr., senior research scientist, Structural Dynamics Division, Langley Research Center, has been selected 1989 Black Engineer of the Year for Outstanding Achievement in Government.

The Black Engineer of the Year awards were created to pay tribute to Black Americans for their contributions in the areas of science, engineering and technology. The awardees also provide positive role models for minority youth.

Whitlow and other award winners were honored February 25, at a banquet held at the Baltimore Convention Center. The banquet is the culminating event of a three-day conference sponsored by Mobil Oil, the Council of Engineering Deans of the Historically Black Colleges and Universities and Career Communications Group, Inc., publishers of U.S. Black Engineer magazine.

Whitlow joined the research staff at Langley in July 1979 as an aerospace technologist. Now a senior research scientist in the Unsteady Aerodynamics Branch, Whitlow is an internationally-known researcher in computational unsteady fluid dynamics.

His personal research is highly original and involves the development of theoretical and computational methods for predicting air forces on flight vehicles.

He has received NASA Special Achievement Awards for developing new methods for predicting aerodynamic loads and for developing new methods for analyzing aircraft structures.

As impressive as his professional accomplishments are his contributions to the community. He is a strong advocate of minority participation in all phases of science and engineering and is active in promoting science and engineering careers in the local school systems. A volunteer tutor in the local high schools and colleges, Whitlow has also evaluated proposed papers for technical symposiums organized by the National Technical Association for minority college students.

In the spring of 1988, Whitlow, with Old Dominion University (ODU) and the Cooperating Hampton Roads Organizations for Minorities in Engineering (CHROME), helped establish an Institute for Minorities, for youth interested in science and engineering careers. During the eight-week program, 21 Hampton Roads' minority students in grades 6, 7, and 8 attended ODU on Saturdays for computer instruction and for laboratory experiments in science and engineering disciplines. ■

Congress

from page 17

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Ted Stevens (AK)**
Bob Kasten (WI)**
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